



Standardized Initial Margin Model

Initial Margin

Margin Introduction

- ◆ Initial Margin is the amount of collateral required to open a position.
- ◆ Maintenance Margin is the minimum amount of collateral required to keep the position open after inception.
- ◆ $\text{Margin Balance} = \text{Asset value} - \text{Borrowed fund}$
- ◆ Margin Call: the broker issues a margin call that requires the investor to bring the margin balance back to initial margin if margin balance is below maintenance margin.

Initial Margin

Initial Margin Scope

- ◆ Initial margin calculation is counterparty-portfolio-based.
- ◆ Initial margin calculation in a bank contains non-cleared OTC derivatives only as cleared products are already covered by Exchanges
- ◆ Derivative trades belonging to a counterparty will be divided into a cleared portfolio and a non-cleared portfolio. The initial margin is computed for the non-cleared portfolio.

Initial Margin

Initial Margin Calculation hierarchy

- ◆ Calculation is conducted from the lowest level to the highest one:
risk factor → risk bucket → risk measure → risk class → product class → final initial margin
- ◆ Define 4 product classes
 - ◆ Interest Rates and Foreign Exchange Product (RatesFX)
 - ◆ Credit Product
 - ◆ Equity Product
 - ◆ Commodity Product

Initial Margin

Initial Margin Calculation hierarchy (Cont'd)

- ◆ Define 6 risk classes
 - ◆ Interest Rate
 - ◆ Credit (Qualifying): non-securitization and simple securitization
 - ◆ Credit (Non-Qualifying): complex securitization
 - ◆ Equity
 - ◆ Commodity
 - ◆ FX
- ◆ Define 3 risk measures
 - ◆ Delta
 - ◆ Vega
 - ◆ Curvature

Initial Margin

Initial Margin Calculation hierarchy (Cont'd)

- ◆ Define risk buckets
 - ◆ Interest rate bucket: based on currency (USD, EUR, CAD, ...)
 - ◆ Credit bucket: based on credit quality (sovereign, financial, technology, ...)
 - ◆ Equity bucket: based on sector (financial, industrial, ...)
 - ◆ Commodity bucket: based on commodity type (crude, gas, ...)
 - ◆ FX: each FX rate is a bucket
- ◆ Define risk factors
 - ◆ Interest rate curve: 12 yields per curve
 - ◆ Credit curve: 5 spreads per credit cuve
 - ◆ Equity: spot price
 - ◆ Commodity: spot price
 - ◆ FX: spot exchange rate

Initial Margin

Sensitivity Calculation

◆ Delta calculation

- ◆ Interest rate (PV01): $s(i, r_t) = V_i(r_t + 1bp, cs_t) - V_i(r_t, cs_t)$
where r_t - interest rate; cs_t - credit spread; 1bp - 1 basis point; V_i - market value
- ◆ Credit (CS01): $s(i, cs_t) = V_i(r_t, cs_t + 1bp) - V_i(r_t, cs_t)$
- ◆ Equity: $s_{ik} = V_i(EQ_k + 1\%EQ_k) - V_i(EQ_k)$
where EQ_k - spot price of equity k.
- ◆ Commodity: $s_{ik} = V_i(CTY_k + 1\%CTY_k) - V_i(CTY_k)$
where CTY_k - spot price of commodity k.
- ◆ FX: $s_{ik} = V_i(FX_k + 1\%FX_k) - V_i(FX_k)$
where FX_k - spot exchange rate of base currency k.

Initial Margin

Sensitivity Calculation (Cont'd)

- ◆ Vega calculation

$$VR_{ik} = \sum_j \sigma_{kj} \frac{dV_i}{d\sigma}, \quad \text{where } \sigma_{ik} - \text{implied volatility}$$

- ◆ Curvature calculation

$$CVR_{ik} = \sum_j SF(t_{kj}) \sigma_{kj} \frac{dV_i}{d\sigma}$$

where $SF(t) = 0.5 \min(1, \frac{14d}{t})$ is a scaling factor and t_{kj} is the expiry date.

Initial Margin

Initial Margin Calculation

- ◆ A risk weight is defined for each risk factor.
- ◆ A correlation is specified for each risk factor pair.
- ◆ Within a product class, calculate initial margin for each risk class
 - ◆ Net all sensitivities for each risk factor $k \rightarrow s_k$
 - ◆ Compute risk weighted sensitivity $WS_k = RW_k s_k CR_k$
where WS_k - risk weight and CR_k - concentration risk factor
 - ◆ Aggregate weighted sensitivities within each bucket

$$K = \sqrt{\sum_k WS_k^2 + \sum_k \sum_{i \neq k} \rho_{ki} f_{ki} WS_k WS_i}$$

where ρ_{ki} - correlation and f_{ki} - correlation adjustment

Initial Margin

Initial Margin Calculation (Cont'd)

- ◆ Aggregate buckets to obtain a sensitivity initial margin

$$\text{DeltaMargin} = \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc} S_b S_c} + K_{\text{residual}}$$

$$\text{VegaMargin} = \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc} \delta_{bc} S_b S_c} + K_{\text{residual}}$$

$$\text{CurvatureMargin} = \max \left(\sum_{b,k} \text{CVR}_{b,k} + \lambda \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc}^2 S_b S_c} \right) + \theta_{\text{residual}}$$

- ◆ Initial margin for a risk class

$$\text{IM}_x = \text{DeltaMargin}_x + \text{VegaMargin}_x + \text{CurvatureMargin}_x$$

Initial Margin

Initial Margin Calculation (Cont'd)

- ◆ Initial margin for the product class

$$IM_p = \sqrt{\sum_r IM_r^2 + \sum_r \sum_{s \neq r} \Psi_{rs} IM_r IM_s}$$

- ◆ Final initial margin

$$IM = IM_{RateFX} + IM_{Credit} + IM_{Equity} + IM_{Commodity}$$



Reference:

<https://finpricing.com/lib/EqVariance.html>